



# *DoD Science and Technology*

## Executive Forum on Modeling and Simulation

30 May 2001

**Dr. Delores M. Etter**

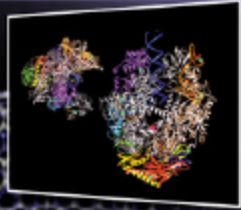
**Deputy Under Secretary of Defense (Science & Technology)**

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# Mission

*... to ensure  
that the warfighters  
today and tomorrow  
have superior and  
affordable technology  
to support their  
missions, and to give  
them revolutionary  
war-winning  
capabilities.*

Office of the Deputy Under Secretary of  
Defense for Science and Technology



# *Defense Science and Technology*





# *A Focus on Revolutionary Advances*

## *Stealth*



## *Adaptive Optics and Lasers*



## *GPS*



## *Night Vision*



## *Phased Array Radar*



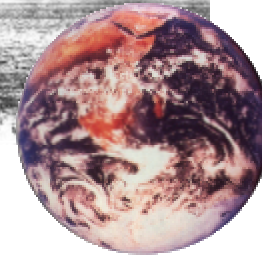




# Strategic Environment

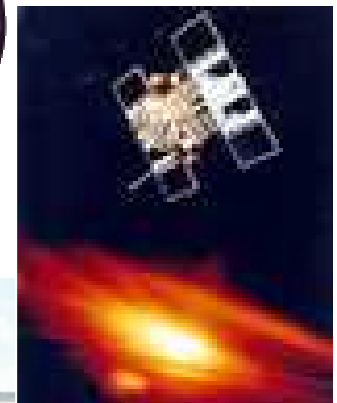
## Global US Interests

*Political - Economic - Humanitarian*



## Asymmetric Threats

*In any domain - Air, Land, Sea, Space or Information*





# FY01 RDT&E

**FY01 RDT&E = \$41.3B**  
**(6.1 thru 6.7)**

**(6.6 + 6.7 = \$15.6B)**

**Development**  
**(6.4 + 6.5 = \$16.7B)**

**Science and Technology**  
**(6.1 + 6.2 + 6.3 = \$9.0B)**

**21% of RDT&E**

**Technology Base**  
**(6.1 + 6.2 = \$5.0B)**

(\$B)

40

36

32

28

24

20

16

12

8

4

0

**6.7 Operational Systems  
Development (\$13.0B)**

**6.6 RDT&E Management  
Support (\$2.6B)**

**6.5 Engineering and  
Manufacturing  
Development (\$8.8B)**

**6.4 Demonstration and  
Validation (\$7.9B)**

**6.3 Advanced Technology  
Development (\$4.0B)**

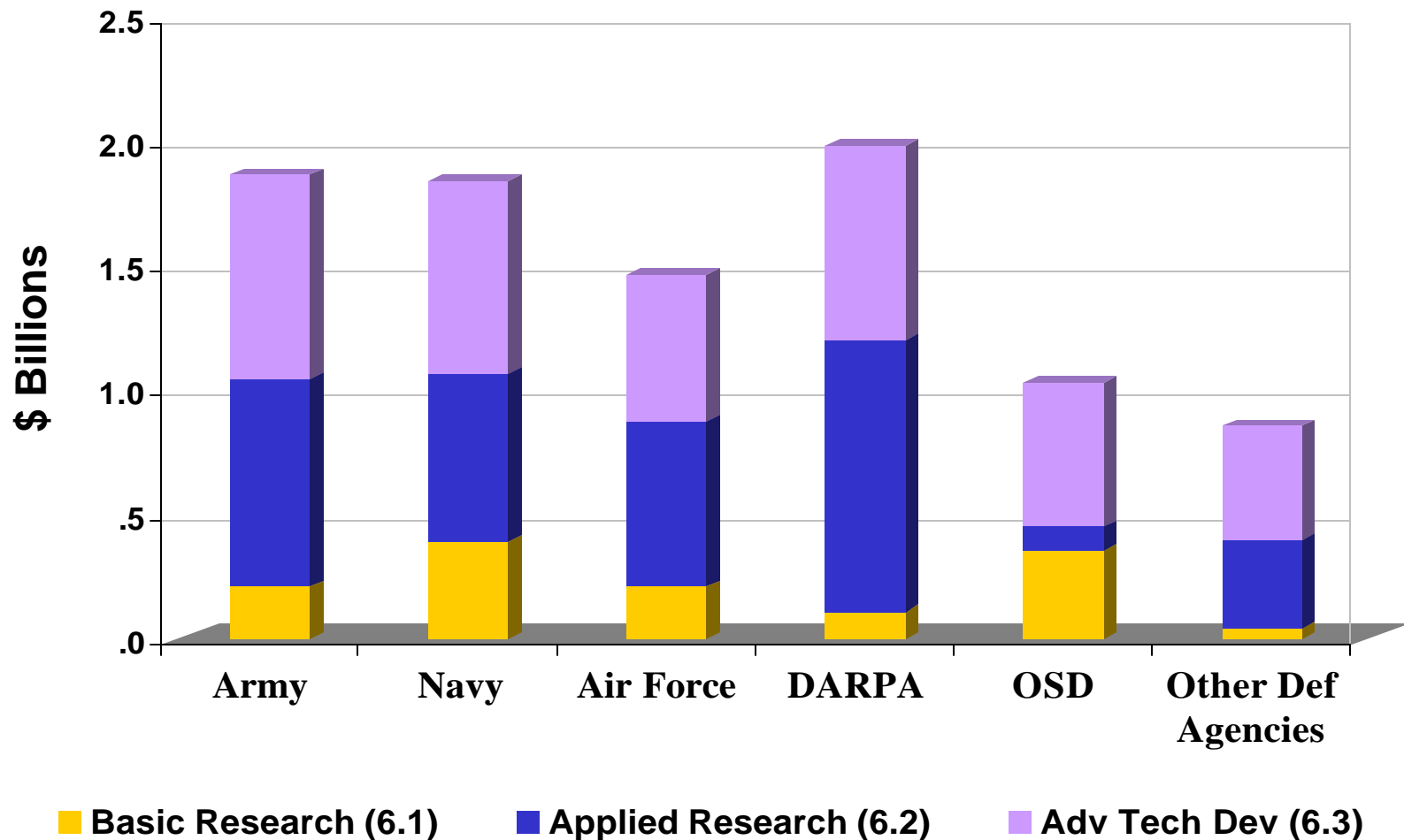
**6.2 Applied Research (\$3.7B)**

**6.1 Basic Research (\$1.3B)**



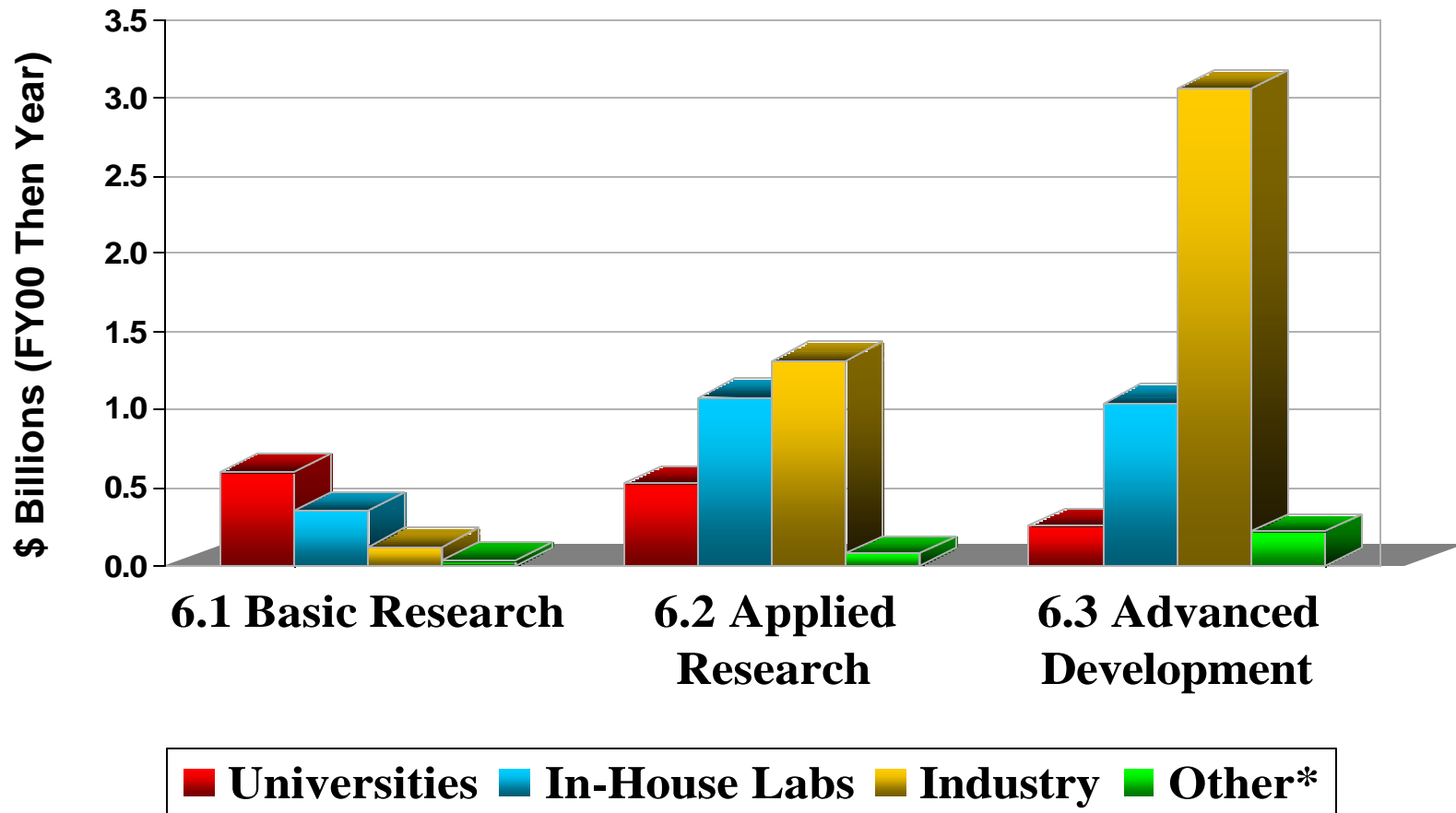
# DoD S&T Investment

***Total FY01 S&T = \$9.0B***





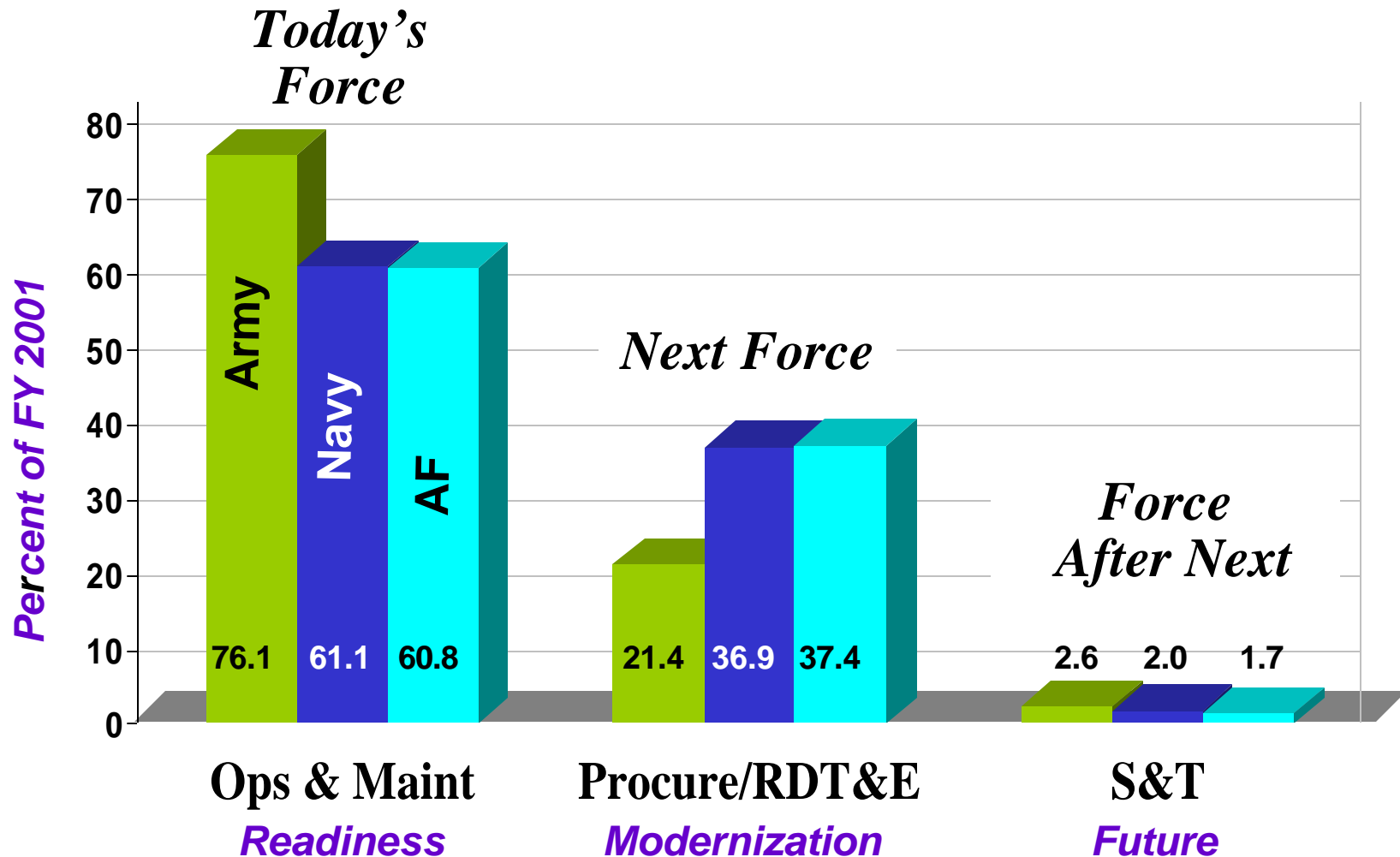
# Recipients of DoD S&T Funds



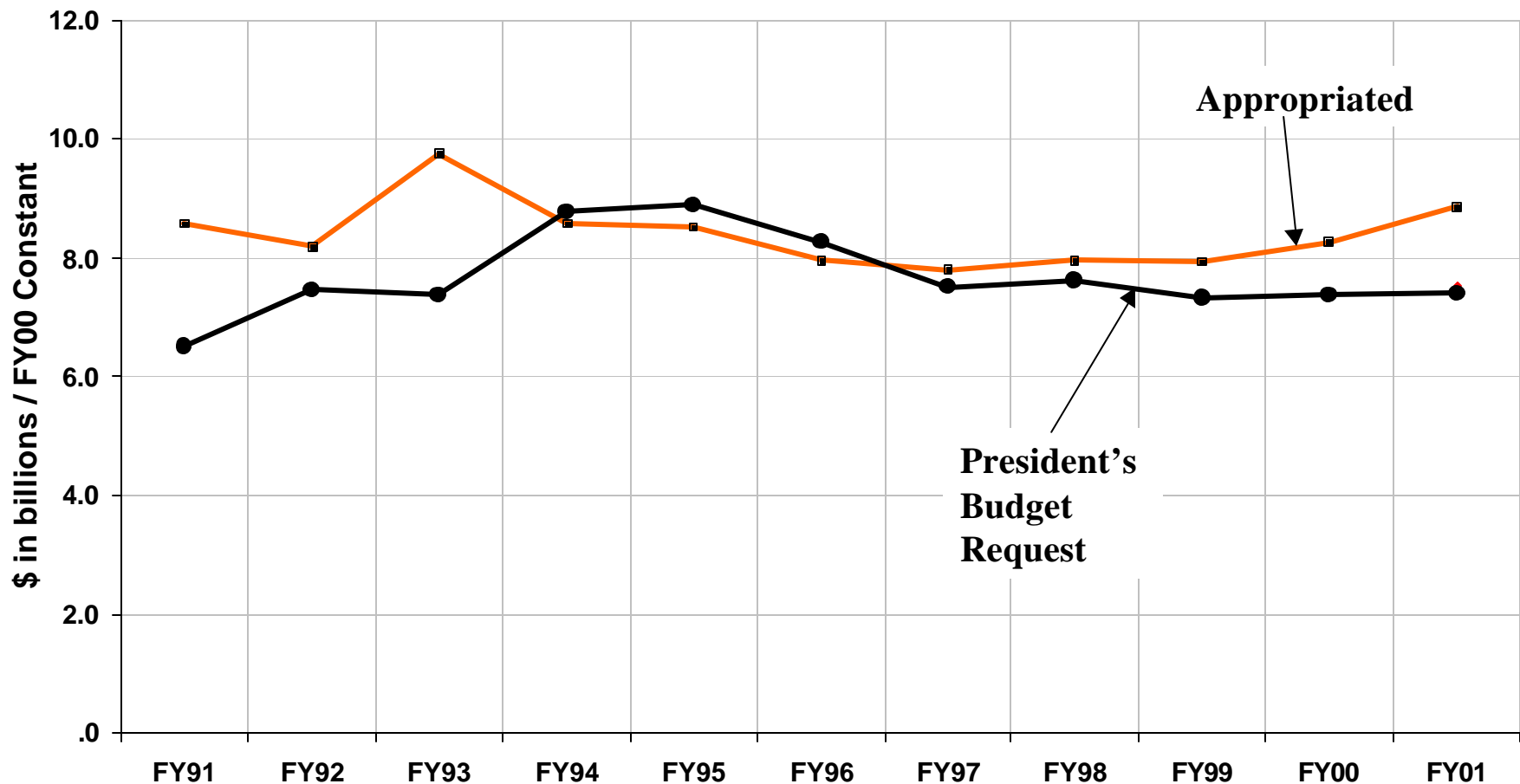
**\*Includes non-profit institutions, State & local govt., & foreign institutions**

Source: National Science Foundation Report, Volume 48 (FY 2000)

# Technology Perspectives FY01



# Department of Defense Science & Technology (S&T)

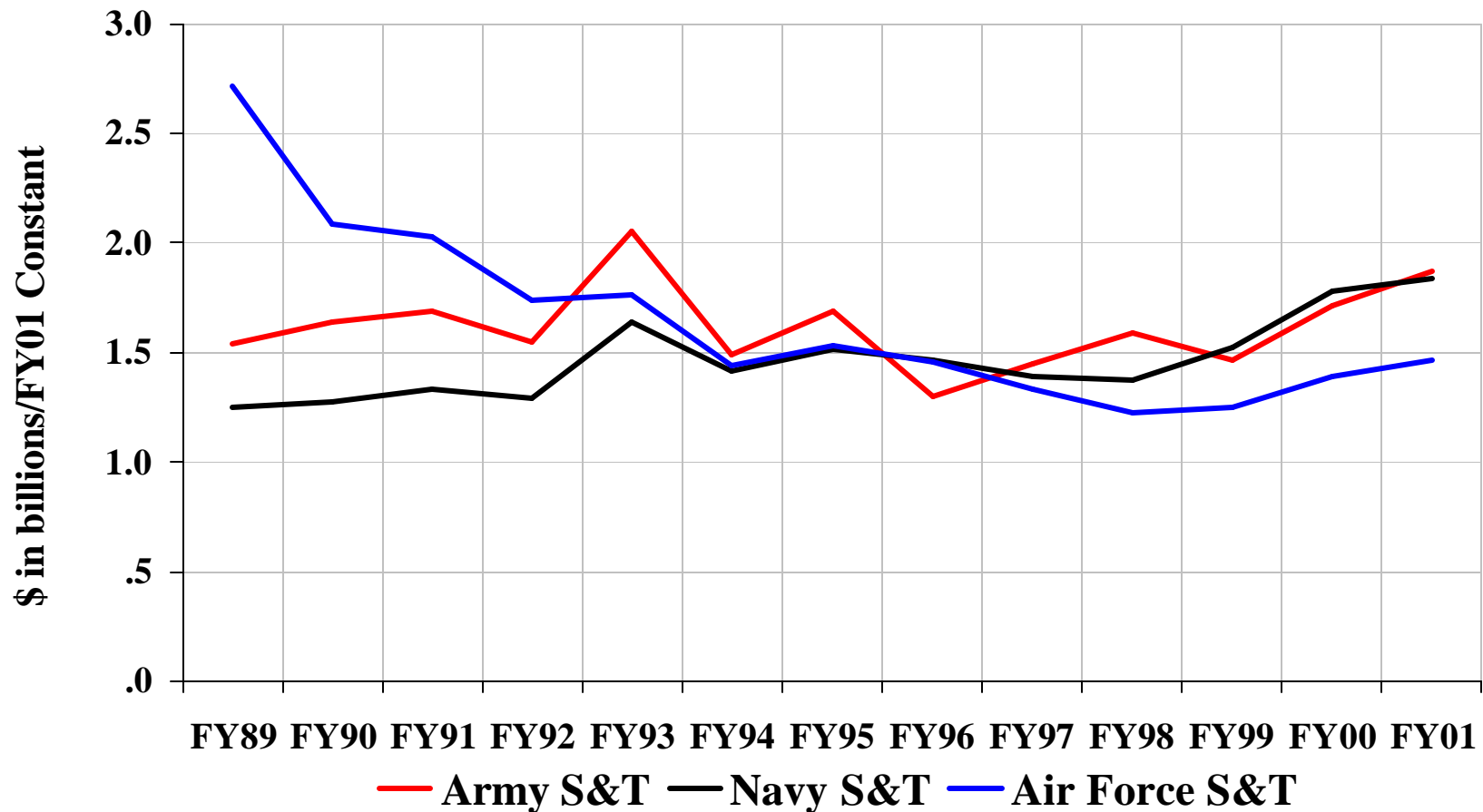




# Service Investment in Science & Technology



## Services Science & Technology (S&T) (6.1, 6.2, 6.3)



# DUSD (S&T) Priorities 2001

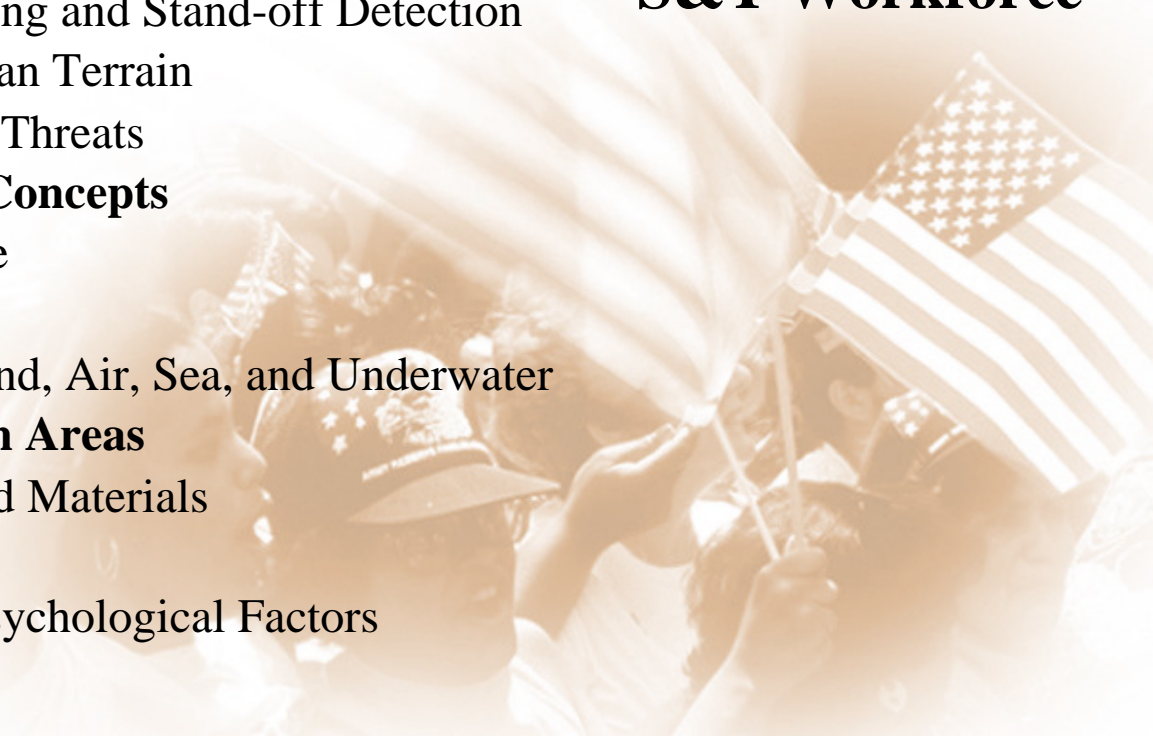


## *Technical*

- **Basic Research**
- **Strategic Initiatives**
  - **Hard Problems**
    - Time Critical, Standoff and Concealed Target Defeat
    - Cruise and Ballistic Missile Defense
    - Chem-Bio Defense Modeling and Stand-off Detection
    - Military Operations in Urban Terrain
    - Counters to Asymmetrical Threats
  - **Revolutionary Warfighting Concepts**
    - Fuller Dominance of Space
    - Network Centric Warfare
    - Unmanned Systems for Land, Air, Sea, and Underwater
  - **Military Significant Research Areas**
    - Nanoscience and Advanced Materials
    - Advanced Power
    - Human Dimensions and Psychological Factors
    - Directed Energy

## *Non-Technical*

- **Funding Stability**
- **Technology Transition**
- **S&T Workforce**



# Basic Research

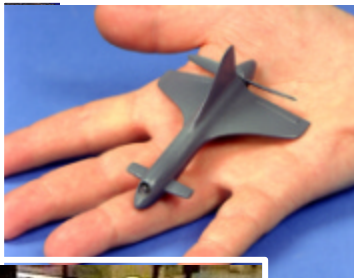


**Microsatellites**



**Joint Strike Fighter**

**Micro Air Vehicles**

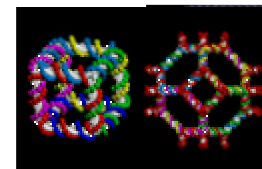
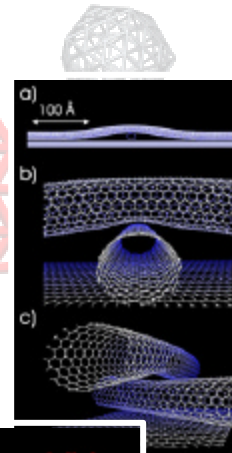
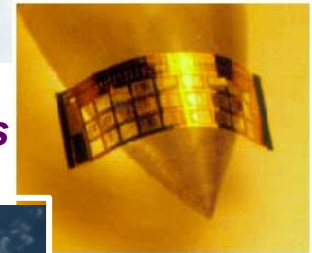


**Micro Robots**



**DD-21**

**Flexible Sensor Skins**

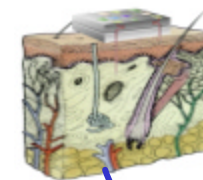


**Nanotechnology**



**Augmented Reality**

**Bio Sensors**



**Embedded Biofluidic Chips**



**Handheld**



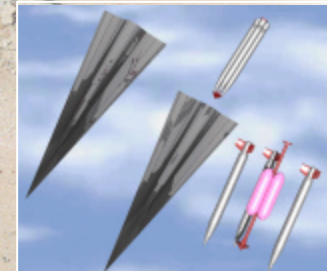
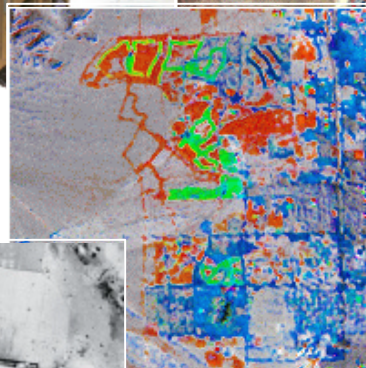
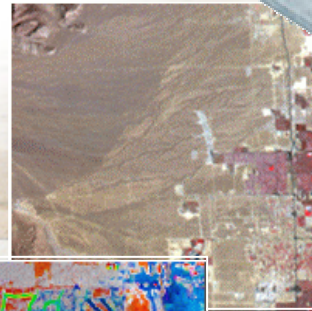


# Hard Problems



## Time Critical, Standoff, and Concealed Target Defeat

- **Locate**
- **Characterize**
- **Defeat**
- **Assess**



*Hardened and Deeply Buried Targets*  
*Concealed Targets*  
*Slowly Moving Targets*

*Provides capability to safely identify and strike intended targets.*

# Cruise and Ballistic Missile Defense



- **Detect**
- **Track**
- **Negate**
- **Protect**

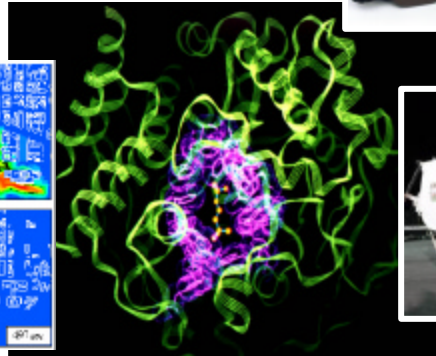
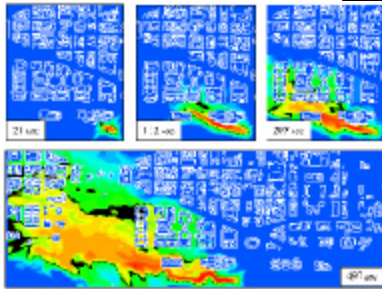


*Provides capability to remotely detect, track, and negate cruise and ballistic missile threats.*



## Chem-Bio Defense Modeling and Stand-off Detection

- **Detect**
- **Predict**
- **Characterize agent toxicity**
- **Determine genetic/chemical composition**
- **Model & simulate**

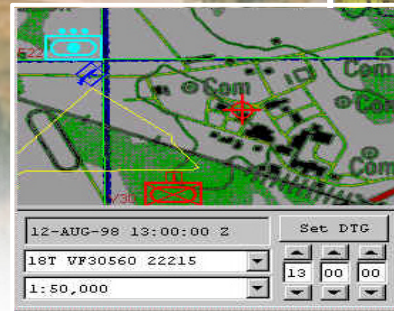


*Provides real-time capability to remotely detect chemical and biological agents and forecast their dispersion.*



# Military Operations in Urban Terrain

- *Enhance understanding*
- *Improve training*
- *Expand mission rehearsal capabilities*
- *Provide fast, safe breaching capabilities*
- *Neutralize threat*



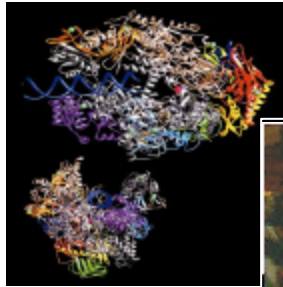
*Provides capability to engage threat forces in an urban environment.*

# Counters to Asymmetrical Threats



- **Understand unconventional threats**
- **Predict human behavior**
- **Develop decision support aids**
- **Dissuade**

*“Win without fighting”*



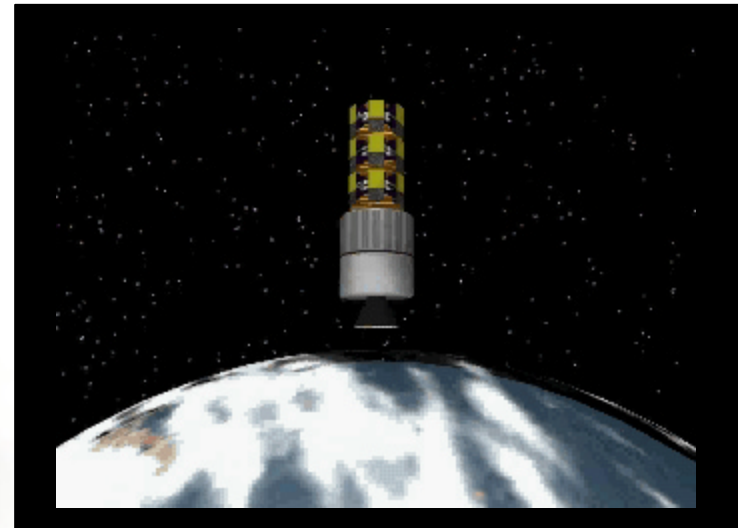
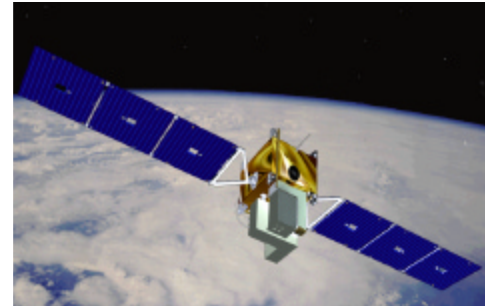
*Provides improved information operations, computational models, and social science theory to allow commander to shape engagement without force.*

# Revolutionary Warfighting Concepts

## Fuller Dominance of Space



- *Develop affordable space transportation*
- *Assure space surveillance*
- *Control space*
- *Protect on-orbit assets*
- *Apply force from space*



*Provides capability to fully exploit space, conducting operations at will.*



# Revolutionary Warfighting Concepts

## Network Centric Warfare



- **Develop robust connectivity and interoperability**
- **Provide information assurance**
- **Improve decision support**
- **Exploit high performance computing**

### *Smart Sensor Web*



### *Software Intensive Systems*

*Provides increased combat power by networking sensors, decision makers, and mission executors, to achieve shared awareness, self-synchronization, and improved operations.*

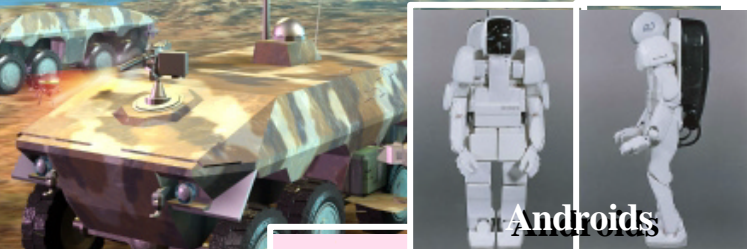
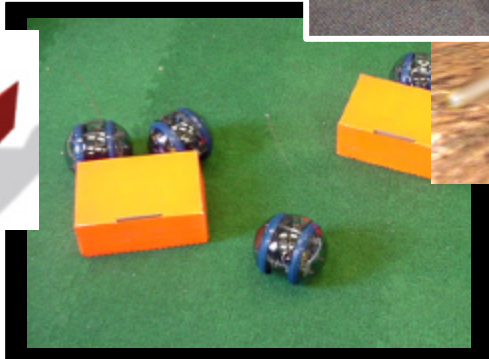


# Revolutionary Warfighting Concepts



## Unmanned Systems for Land, Air, Sea, and Underwater

- **Control assets remotely**
- **Miniaturize components**
- **Integrate information**
- **Develop collective behavior**
- **Develop distributed operations**



*Provides capability to safely execute an expanded range of missions .*

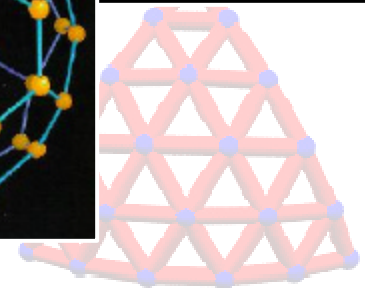
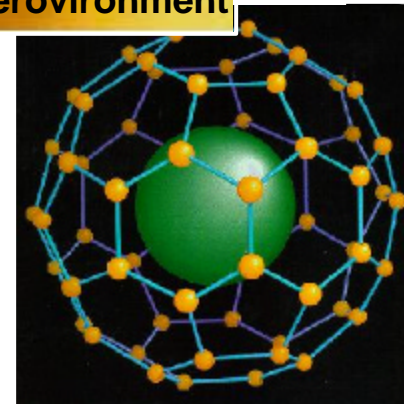
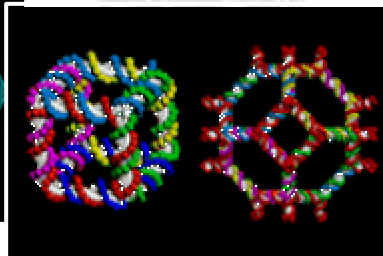
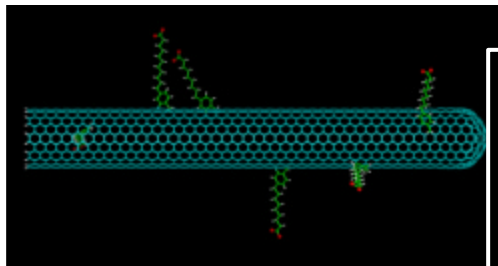
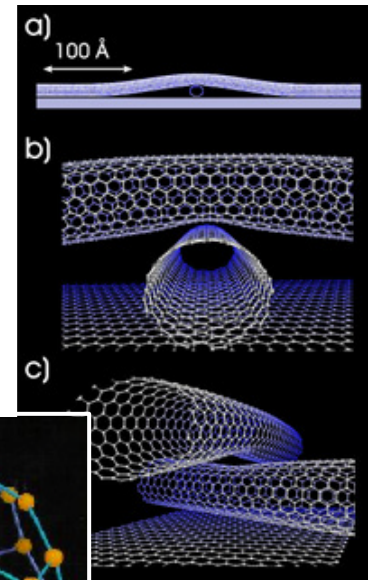
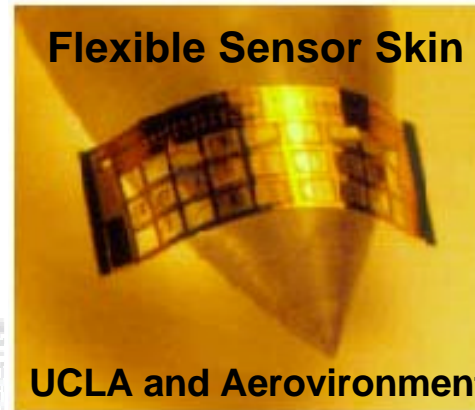
# Militarily Significant Research Areas

## Nanoscience and Advanced Materials



- **Exploit:**

- Carbon computers
- Molecular engineering
- Nanoscale robots, sensors, machines
- Battery electrode and energy storage
- Vacuum microelectronics devices
- Molecular composites



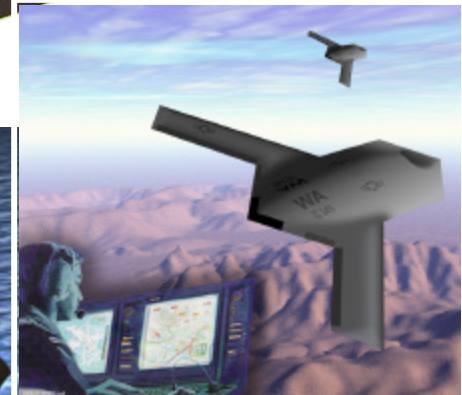
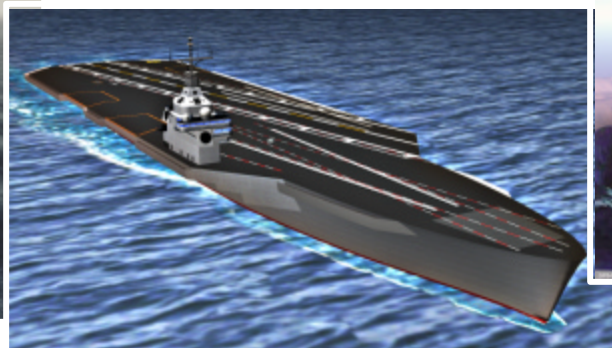
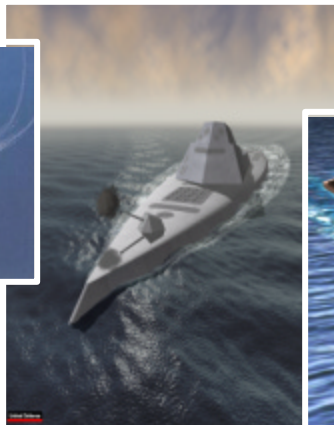
*Provides opportunity to develop totally new operational concepts and capabilities.*

# Militarily Significant Research Areas

## Advanced Power



- *Improve energy storage and release*
- *Enhance power generation/distribution*
- *Develop new power applications*
- *Exploit electric drive*
- *Enhance propulsion technologies*



*Provides opportunity to more efficiently project a capability throughout the battlespace.*

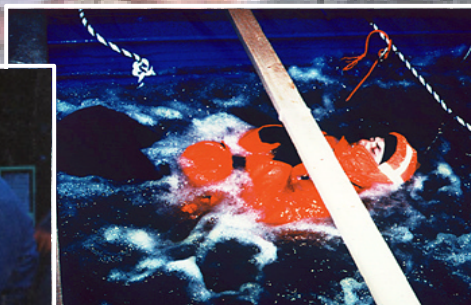


# *Militarily Significant Research Areas*

## Human Dimension and Psychological Factors



- *Improve training aids*
- *Develop decision making skills*
- *Improve cognitive readiness*
- *Enhance performance*



*Provides opportunity to improve human information recognition and retention.*

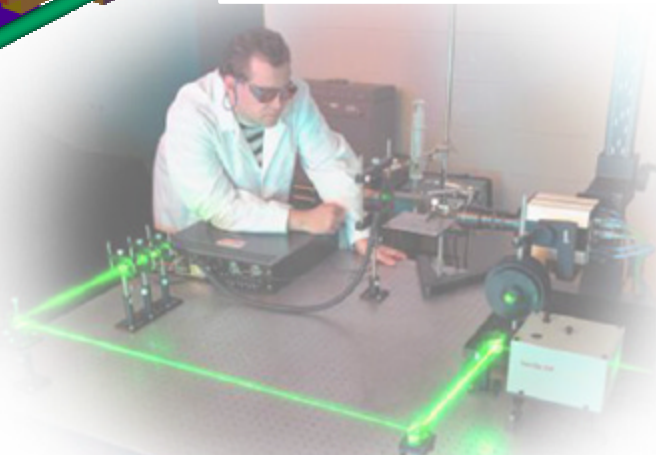
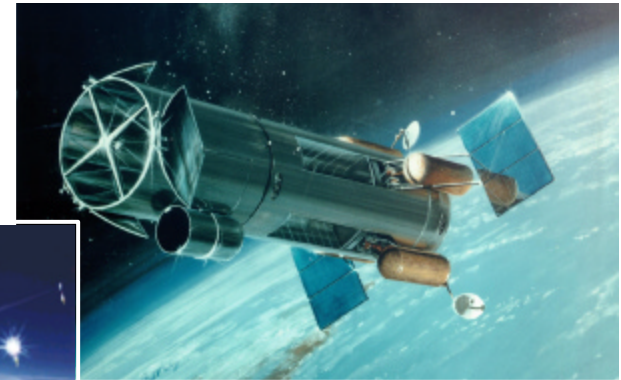
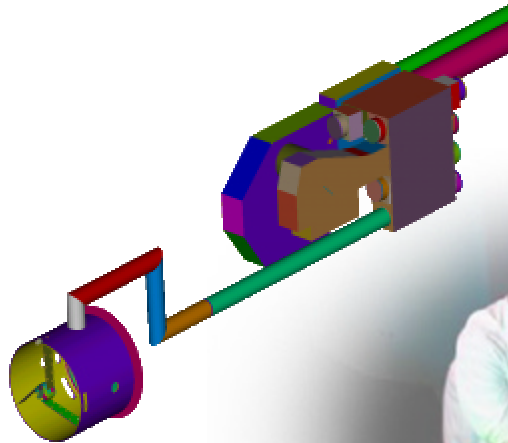


# Militarily Significant Research Areas

## Directed Energy



- **Exploit:**
  - **High energy lasers**
  - **High powered microwaves**



*Provides opportunity to revolutionize operations in traditional battlespace environments.*

# Defense Modeling & Simulation Office Vision



“**Lead** and **Integrate** the DoD M&S community, and **Leverage** M&S science and technology advances to ensure that the warfighters of today and tomorrow have superior and affordable M&S tools, products and capabilities to support their missions and to give them revolutionary war-winning capabilities.”

*Lead, Integrate and Leverage M&S  
for the Warfighter*



# Defense Modeling & Simulation Office Priorities



- **Joint Warfighter Requirements**
  - Support to CINCs & Services
  - Joint Program Support (JSIMS, JMASS, JWARS) & Integration
- **Enterprise Activities**
  - High Level Architecture Transition
  - Simulation Interoperability Standards
  - Synthetic Environment
- **Science & Technology Initiatives / Concepts Applications**
  - Human and Group Behavior
  - Simulation Based Acquisition
  - Technology Demonstration
- **Community Services & Coordination**
  - M&S Integration Task Force & DoD M&S Master Plan
  - M&S Information Analysis Center
  - M&S Resource Repository
  - Outreach

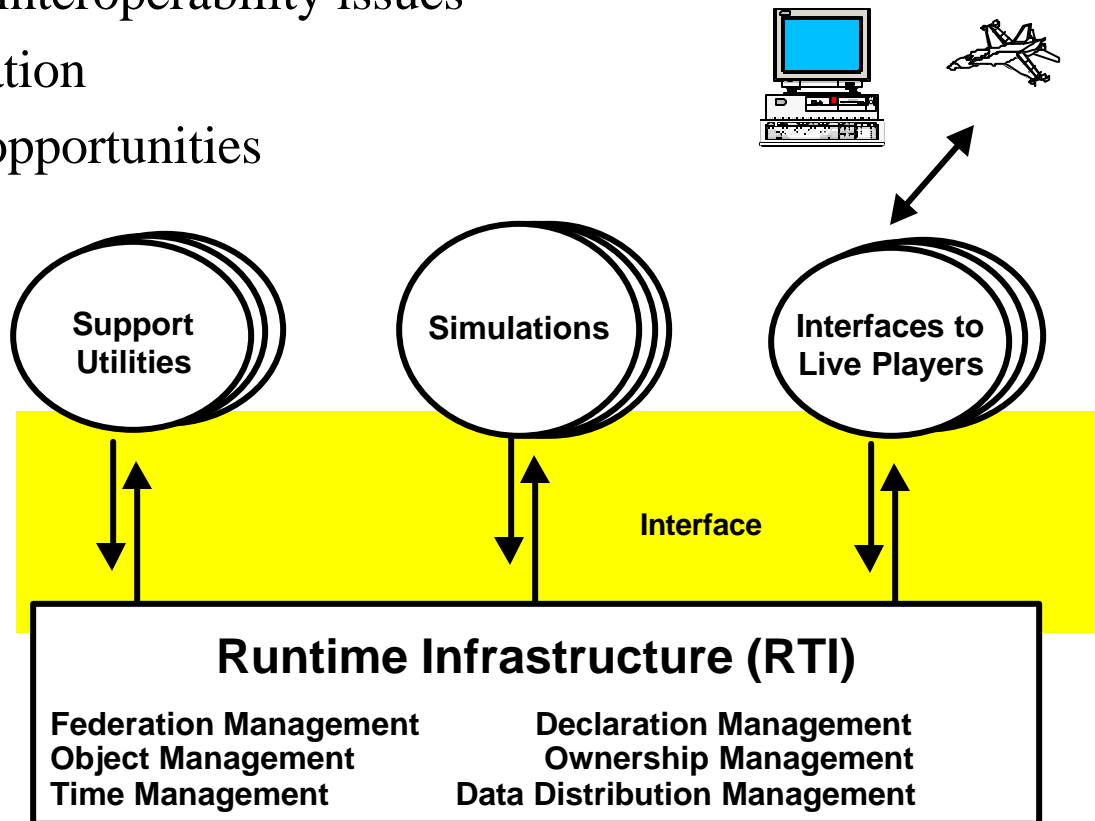


# *DMSO Accomplishment:* High Level Architecture (HLA)



*HLA: technical architecture for interoperability and reuse - Nov 2000*

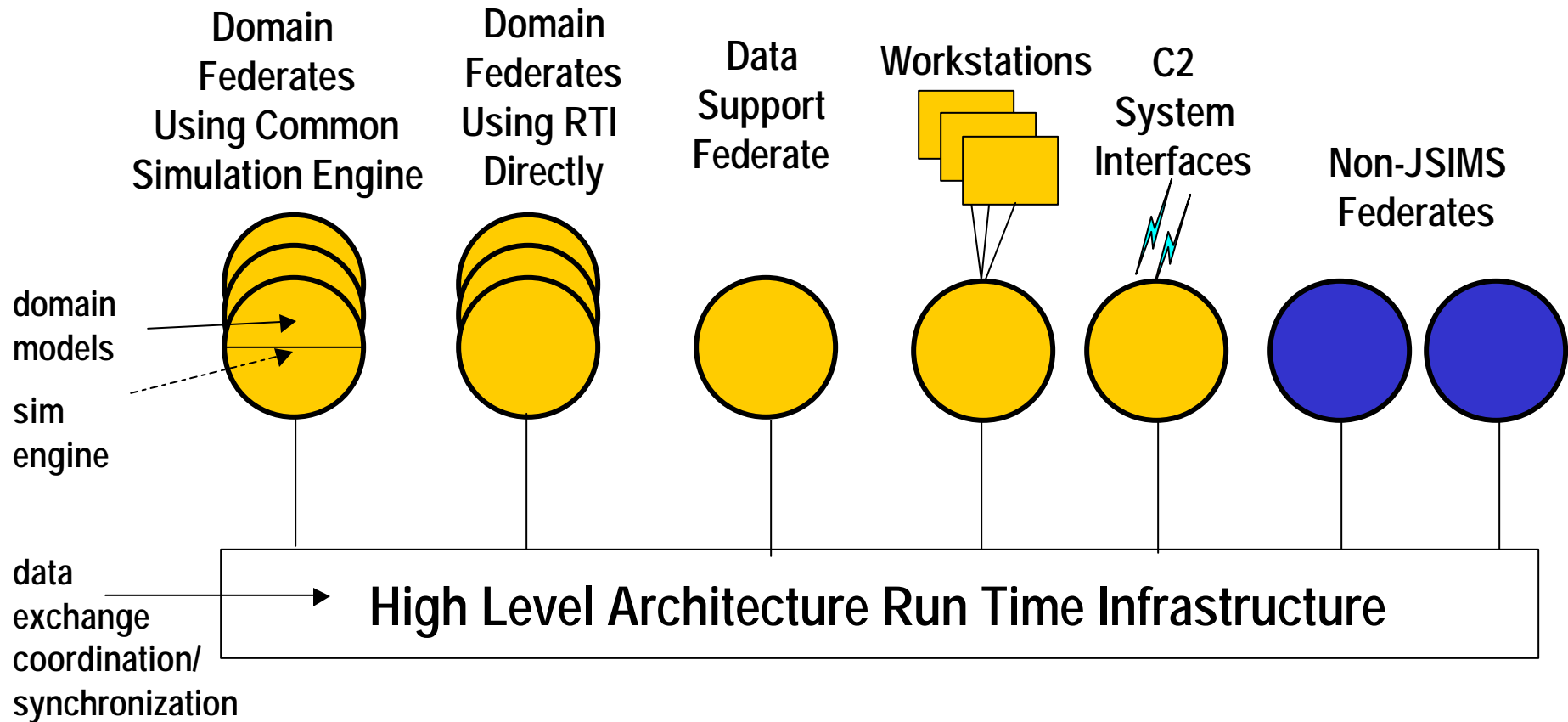
- IEEE standardization
- Focused community on real interoperability issues
- Enabled cross domain federation
- Created reuse products and opportunities
- Brought rigorous systems engineering to federation development
- 60% to 80% community technology adoption (SEI study)







# Joint Simulation System (JSIMS)





# JOINT SIMULATION SYSTEM (JSIMS)

## JSIMS ALLIANCE ACROSS THE NATION



## MISSION

To provide...

A computer-simulated environment...

For use by CINCs, joint organizations, and the Services...

To educate, train, and develop doctrine and tactics...

For Joint warfighting and other operational needs.

National Simulation (NATSIM) -- Reston, VA  
National Intelligence Systems

Joint SIGINT Simulation (J-SIGSIM) -- Columbia, MD  
Signal Intelligence

National Air and Space Model (NASM)  
Hanscom AFB, MA  
Air and Space Domain

NRO  
NSA  
DIA

DOMINO -- Bolling AFB, Wash, DC  
DIA National Intel Process Modeling

DMSO -- Alexandria, VA  
High-Level Architecture

MARCORSYSCOM

USMC DA -- Orlando, FL  
USMC Requirements

STRICOM  
Warfighters' Simulation (WARSIM) -- Orlando, FL  
Land Domain

WARSIM Intelligence Module (WIM) -- Orlando, FL  
Tactical Intelligence

JSIMS Maritime -- San Diego, CA  
Maritime Domain

SPAWAR

NASM Joint Operations & ISR  
Simulation (JOISIM) -- San Antonio, TX  
Airborne Sensors

JIOC

JSIMS Joint DA -- Orlando, FL  
Joint Domain

Joint

# *DMSO Accomplishment:*

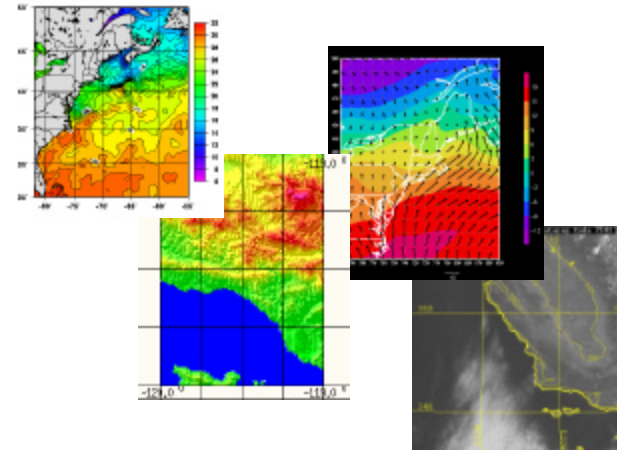
## Integrated Natural Environment Program



*Provides the warfighter integrated authoritative representations of the natural environment*



*Effect of high winds on concealment smoke changed outcome of the battle.*



*Environmental data from the various domains*

- Released SEDRIS Interoperability Standards and software tools
- SEDRIS specified in acquisition of Army, Joint, and NATO systems
- Demonstrated use of dynamic run-time natural environment
- Increased environmental data records available in library by 30,000



# Current DMSO Focus: Human Behavior Representation



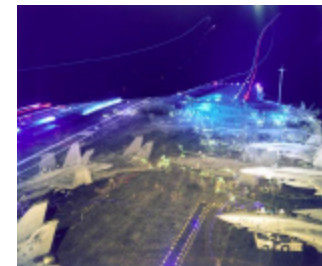
**Training**



**Systems Analysis**

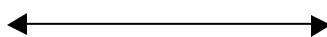


**Command Decision  
Aiding**

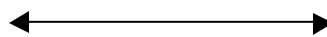


**System Acquisition**

**Individuals**



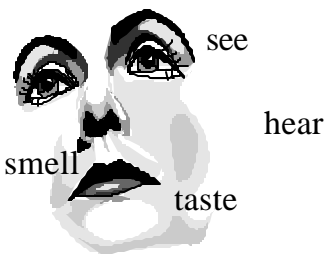
**Teams**



**Organizations**

**Human Behavior represented within M&S:**

*Sensing &  
Perception*



*Physical  
Movement*



*Information  
Processing*



*Decision  
Making*



*Communication  
& Coordination*



**Vision:** To enhance warfighter decisions by enabling valid models using credible data that reflect realistic human behavior.



# *DMSO Accomplishment:* Service Academy Outreach



- M&S laboratories enhanced at all three Academies
- Summer interns (6 to 10 per Academy)
- Visiting M&S professors
- Doubled simulation-based training at Academies



# S&T Requires Strong Partnerships

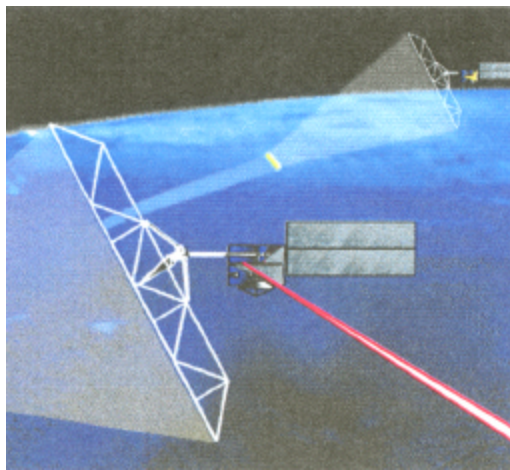


**Link to the Warfighter**



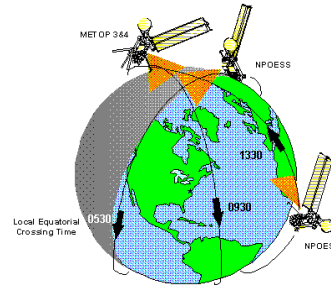
**Service Labs**

**DARPA**



**High Risk, High Payoff**

**Expanded Resource Base**



**Interagency**

**Maximum National  
Security Payoff**

**International**



**Coalition Capability**

**New Ideas, Knowledge**



**Universities**

**Industries**



**Innovation, Transition**



# *A Focus on Tomorrow's Possibilities*



**T**echnical Superiority is  
Critical for National Security.

In peace, it provides deterrence;

In crisis, it provides options;

In war, it provides an edge."

Defense Science and Technology Strategy  
May 2000

